REDACTED VERSION

DECLARATION OF MICHAEL BOWKER

I, MICHAEL BOWKER, state as follows:

1. I have been asked by PlanetSpace Inc. to provide this declaration in connection with certain "public interest" issues that may be relevant to PlanetSpace's bid protest.

2. I have over 25 years experience working in the aerospace industry, including 3 years as a NASA project manager, and twenty-two years with private industry supporting NASA programs. I have significant experience with aerospace technical operations and program management.

3. I am a graduate of the Florida Institute of Technology with a Bachelor of Science in Ocean Engineering (1982).

4. I am presently the Principal at Bowker and Associates, a consulting company providing program management, strategic business development, and negotiating strategy support to aerospace clients. I participated significantly in the preparation of PlanetSpace's bid proposal in this matter. If PlanetSpace is awarded a contract, I will be the Chief Operating Officer of PlanetSpace. My role as COO will be to provide a single point of authority and responsibility to NASA on all ISS CRS activities, and to co-ordinate the activities of the participating subcontractors -- Lockheed Martin, ATK, and Boeing for the ISS Commercial Resupply Contract (CRS).

5. Between 2007 and 2008, I served as Senior Vice President and Chief Operating Officer of SPACEHAB, Inc. During my tenure at SPACEHAB, I established a wholly-owned subsidiary, SPACETECH, to commercialize and market products made in microgravity and those products made for the space industry.

6. Prior to joining SPACEHAB, I held several positions at EADS – Astrium North America Inc. between 2002 and 2007, including CEO and President. At EADS, I was instrumental in negotiating a teaming agreement with Lockheed Martin to help develop the NASA Human Space Program Crew Exploration Vehicle. My role in the company included aspects of management and operations for EADS efforts on the CEV project.

7. Between 1998 and 2002, I held several management and technical operations positions at SPACEHAB Inc., including positions with direct oversight and management responsibilities in the development a new external cargo carrier for use on the U.S. Space Shuttle. This system was one of the first commercial, fixed price cargo delivery services sold for use on the Space Shuttle.

8. Between 1991 and 1998, I held the positions of Director and site manager at United Space Alliance, LLC, Rockwell International Inc. There, I responsible for the direction, definition and approval of all projects relating to the various technical systems and their evolution, maintenance and upgrade. I was responsible for assurance that system configurations for the Space Shuttle Vehicle met approved requirements. In addition, I led a United Space Alliance task force that overhauled the Space Shuttle's 212 technical information systems, resulting in a migration from legacy mainframe environment to a client-based architecture of 15 systems/applications.

9. Between 1988 and 1991, I was a project manager at the National Aeronautics and Space Administration ("NASA"). There I was member of the Systems Engineering and Integration (SE&I) Office for Kennedy Space Center's (KSC) participation in the Space Station Freedom Program. I was responsible for Kennedy Space Center's Assured Crew Return Vehicle (ACRV) requirements and configuration management system.

10. Prior to NASA, I was a systems engineer at Lockheed Space Operations Company responsible for the test, checkout, validation, maintenance, design evolution, and launch commit criteria for the following systems: (1) Orbiter Access Arm (2) Sound Suppression System, and (3) Hydraulic Charging Unit. My responsibilities included ensuring these systems' readiness to support the Space Shuttle Program's launches and integrated tests. I supported 15 Shuttle launches (STS -11 thru STS -25 Challenger) from the Cape as part of the Lockheed Martin launch team engineer responsible for 5 Launch Commit Criteria (LCCs). In addition, I was responsible for all systems engineering for the Orbiter Access Arm (OAA) to support the Space Shuttle's Return to Flight (STS-26) after the 1986 Challenger failed launch.

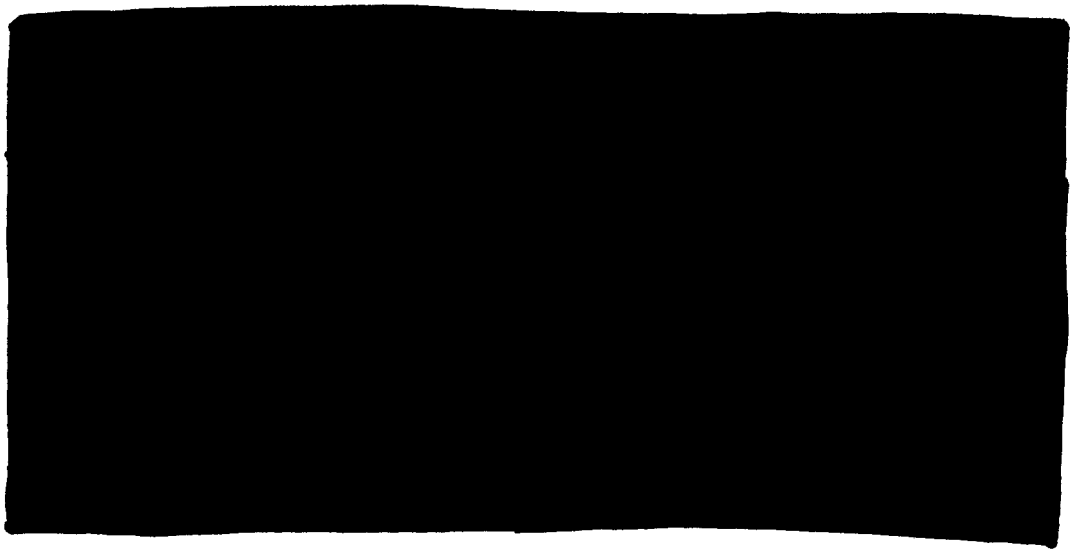
11. In forming this opinion, I have reviewed PlanetSpace's proposal and the evaluation. In addition, I have reviewed public information pertaining to SpaceX and Orbital's performance on their Commercial Orbital Transportation Agreements (COTS). I note that in making its source selection decision, NASA used a May 28, 2008 past performance cut off date (the due date of the Past Performance Volume). Because of this cut-off date, the submittals would not have included information related to schedule slips and performance problems encountered by SpaceX and Orbital in the performance of their COTS agreements occurring during the six month period prior to award. In addition, both contractors have experienced additional problems that bear on timely performance of ISS resupply missions, and hence, the public interest.

12. Based on these materials and my experience, and for the reasons explained more fully in the remainder of this declaration, it is my professional opinion that PlanetSpace can be ready to launch within [redacted] of a contract award to it. Based on this opinion, and if a contract were awarded in the next 30 days, the resulting first mission date would be only [redacted]

later than if PlanetSpace had originally been awarded a contract. Given the delays already encountered by SpaceX and Orbital and likely additional delays, I believe that PlanetSpace's first mission is likely to occur before either of the winning bidders' first missions.

Planet Space Mission Timelines

13. PlanetSpace's final proposal stated that the company would be able to provide resupply services to the International Space Station (ISS) beginning in 2011. PlanetSpace proposed the following program schedule in its bid proposal:



14. Based on the efforts that have been undertaken by PlanetSpace and its subcontractors since contract award, as well as the high percentage of heritage hardware to be used in the performance of PlanetSpace's bid, the resources available to it, both in the form of the experience and capabilities of its subcontractors and its financial plan, I believe that PlanetSpace will be able to meet a schedule substantially similar to the one it originally proposed to NASA in response to RFP NNJ08ZBG001R. Specifically, it is my opinion that PlanetSpace would be ready to launch its initial mission with a delay from the initial schedule if

it were awarded a contract within the next 30 days. PlanetSpace would catch up to its original mission schedule by [redacted] The revised schedule is as follows:

[redacted]

Heritage Hardware Allows For Expedited Mission Readiness and Low Risk

15. There are four systems required for any company to be ready to provide resupply services to the International Space Station: 1) a qualified launch facility; 2) a qualified launch vehicle; 3) a qualified upper stage; and 4) an orbital transfer vehicle capable of carrying the cargo and successfully rendezvous with the International Space Station. While these systems can be developed simultaneously given enough financial, engineering, and production resources, the systems operate interdependently. As such, a delay in one system can result in a delay in the readiness all of the others, and thus a delay in the overall mission schedule. A substantial reduction in total development time and risk of schedule delay can be achieved by reducing the number of newly developed, and thereby unproven, systems used to achieve mission capability. In short, the use of flight proven systems reduces cost, engineering complexity, and, thereby, the need for lengthy and uncertain development schedules.

16. For its first mission, PlanetSpace proposes to rely on the existing Atlas V launch pad at Cape Canaveral Air Force Base, the existing, flight-proven Atlas V launch vehicle,

a newly developed upper stage, and an orbital transfer vehicle with high heritage component content. More specific information is as follows.

17. **A Qualified Launch Facility**. A qualified launch facility includes a launch pad, ground systems, fueling apparatus, and other systems used to launch a launch vehicle. As noted above, PlanetSpace plans to use the existing qualified launch facility where all other Atlas V rockets have been launched.

18. **A Qualified Launch Vehicle**. The Atlas V launch vehicle is an existing launch vehicle that has flown successfully 85 times. The Atlas V launch vehicle is manufactured by the United Launch Alliance, a joint venture formed by PlanetSpace subcontractors Lockheed Martin and Boeing.[1] Together, the Atlas and Delta have a better than 95% success rate. Another joint venture of these companies, the United Space Alliance, manages the Space Shuttle program. These rockets have flown numerous US-Government missions, including launching satellites for the Department of Defense, NASA, and the National Reconnaissance Office; satellites, exploration vehicles, and probes for NASA. The United Launch alliance has also launched numerous commercial missions for telecommunications satellites.

19. For the remaining missions, PlanetSpace proposes to use a launch vehicle, the Athena III, based on existing, flight-proven launch vehicles: the Athena I and II.

20. Because the Atlas V is an existing launch vehicle requiring no modification or development before it is employed in ISS CRS operations, the main schedule drivers for the first mission -- that is, the steps most relevant to determining when the first resupply mission to the ISS can take place -- are the development of the orbital transfer vehicle, including qualification

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[1] The Delta launch vehicle itself has flown successfully approximately 130 times.

for International Space Station operations (ISS Integration) and the development of the upper stage.

21. The main driver for the remaining missions is the development of Athena III launch vehicle. However, should the Athena III launch vehicle not be ready, the Atlas V could be used for additional, or even all, missions.

First Launch Schedule Drivers

Orbital Transfer Vehicle

22. PlanetSpace proposed to rely on Lockheed-Martin to develop the orbital transfer vehicle, with Boeing providing support for ISS integration activities. The same orbital transfer vehicle will be used in all missions regardless of whether the launch vehicle is the Atlas V or the Athena III.

23. Lockheed Martin has built hundreds of orbital spacecraft, and the design requirements and challenges of an orbital vehicle designed to rendezvous with an already orbiting object are well known to it. It is my understanding that Lockheed Martin routinely accomplishes clean sheet design, certification, and production of orbital spacecraft [redacted]

24. The orbital transfer vehicle that Planet Space proposes to use is not a "clean sheet" start from scratch design. Rather, the orbital transfer vehicle is based on a design Lockheed Martin developed pursuant to a prior NASA contract. The design derives from a spacecraft intended to rendezvous with the Hubble Space Telescope, attach itself to the Telescope without disturbing its orbit, and perform autonomous repairs. NASA cancelled the contract after determining it would use a manned Space Shuttle/Spacewalk mission to perform needed repairs, but not before the spacecraft had passed Preliminary Design Review (PDR).

PDR represents a stage of development where specifications and performance characteristics for a spacecraft are determined, representing approximately 20% of the engineering and development work required to develop a complete spacecraft.

25. Much of engineering effort expended on the Hubble Robotic Vehicle (HRV) is directly transferable to the orbital transfer vehicle . The orbital transfer vehicle and the HRV share external and internal structure, solar arrays, propulsion system, and avionics hardware and software.

26. In addition to the development work already performed in connection with the HRV, the avionics system for the orbital transfer vehicle has been further developed during 2009 in conjunction with Lockheed Martin's work on the Orion program. The Orion is the spacecraft currently under development by NASA that is intended to replace the Space Shuttle for manned missions to low earth orbit, and the International Space Station. Lockheed Martin is the prime contractor on this project.

27. Lockheed Martin has expended substantial effort developing the Orion's avionics system and software to safely approach and dock, or berth with the ISS, among other things. These are the same critical activities that the orbital transfer vehicle must be able to accomplish. Several elements of the Orion development work directed toward ISS missions will transfer directly to the orbital transfer vehicle to be used by Planet Space because the systems share the same objective and similar hardware.

Remaining Missions Schedule Driver

Athena III

28. As I have discussed above, PlanetSpace proposes to use an Atlas V launch vehicle for the first ISS resupply mission, and the Athena III launch vehicle thereafter. Because

the orbital transfer vehicle will have been qualified and flown on the Atlas V during the first supply mission, the Athena III and its launch infrastructure will be the only new system for the remaining PlanetSpace launches. In my professional judgment, the Athena III will not pose a serious risk of schedule delay.

29. The Athena III is heavily based on the flight tested Athena I and II launch vehicles. The Athena series was designed by Lockheed Martin from the outset to be capable of expansion into the Athena III configuration with minimal design work. The Athena III is simply an Athena I/II launch vehicle with two Reusable Solid Rocket Motors attached to each side to increase lift mass capability sufficient to carry out ISS resupply missions. The Athena I/II launch vehicle is flight tested, having flown successfully 5 times.

30. The only major components of the Athena III launch vehicle that will require significant development are the Reusable Solid Rocket Motors and the upper stage rocket motor, both of which will be developed by Alliant Techsystems (ATK). ATK has unparalleled experience in rocket engine development, providing engines for the Space Shuttle, the Delta launch vehicles (which have recently been used to launch NASA's Mars missions), and the Atlas II launch vehicles (which were used to launch the Defense Satellite Communications System. ATK will also be providing engines for components of NASA's Constellation project, including for the Ares I crew launch vehicle and Ares V cargo Launch vehicle (NASA's replacement for the Space Shuttle and to be used for future lunar missions).

31. This development work will not pose a risk of delays for the second through tenth PlanetSpace resupply missions that I have described in paragraphs 32-37 because most of the design parameters can be taken from the Reusable Solid Rocket Motors used on the Space

Shuttle – a well-proven system having been flown successfully 196 times, and test fired an additional 38 times.

32. The principal elements of Reusable Solid Rocket development for the Athena III are [redacted] Because the Reusable Solid Rocket for the Athena III is essentially a smaller Shuttle RSRM, each of these elements will have to be redesigned to provide for the proper size, length of rocket burn, thrust profile, and safety margins.

[redacted]

36. None of these design elements will result in a significant schedule risk for the PlanetSpace proposal because each will be completed and tested well before the Athena III will be required to be qualified for flight. This is because many of the required developments for the Athena III RSRM will be tested for use in NASA's Ares I program. For instance, the Ares I program is scheduled to static test fire a nozzle using the same design as that in the Athena III RSRM in early fall 2009 with 3 additional full scale tests prior to PlanetSpace's spring 2012 launch. This Ares test program will provide the CRS program early data and additional confidence in the performance of the nozzle.

37. Based on ATK's past record with rocket motor development and synergies with the Ares I program discussed immediately above, the complete RSRM development cycle for Athena III will take a very conservative

38. As noted above, PlanetSpace intends to use an Atlas V for its initial launch. Because of this, the development of the Reusable Solid Rocket for the Athena III is not a schedule driver for this launch. Nor is it likely to be a schedule driver for any remaining launches. PlanetSpace stated in its proposal that the company may use an Atlas V, if necessary, for any remaining mission. As such, a delay in development of the Athena III will not prevent PlanetSpace from launching payloads to the ISS.

Athena III Upper Stage

39. The Athena III launch vehicle will use a new upper stage. The only new component of the upper stage is the Castor 30 rocket motor, and thus represents the main schedule driver for upper stage development. The remainder of the upper stage is all existing components.

40. Upper stage readiness will not pose a major risk to PlanetSpace's ability to meet its first (second overall) Athena III mission date of [redacted], as provided above.

41. ATK has continued to develop the engine after award, in part, because awardee Orbital plans to use the Castor 30 as part of the upper stage of its Taurus II launch vehicle.

42. Most of the major development and testing of the motor has already been completed. Development and testing of the graphite composite case is reportedly complete. The case was successfully burst tested in October 2008, and it burst exactly at the predicted pressure, demonstrating the required safety factors with margin. In addition, in December 2008, the first motor case, intended for casting and static firing, was structurally load tested to values exceeding flight test requirements. The case passed with all measured strains at or below predictions.

43. Also in December 2008, the first casting of an inert Castor 30 motor was successfully fabricated. Inert propellant, simulating the viscosity/handling of live propellant, was mixed and cast into a composite motor casing. Subsequently, the production casting of an operational Castor 30 occurred in May 2009.

44. The final remaining major test of the Castor 30 prior to availability for customers is a "hot fire" test. During a hot fire test, a Castor 30 is operated on a test stand and

actual performance of the motor is measured against expected performance. The hot fire test was originally scheduled for May 2009, but is now scheduled for December 2009.

45. This approximately 7-months delay in hot fire testing will not impact PlanetSpace's readiness schedule. If the hot fire test delay is indicative of a production delay in Castor 30 availability, it will still be available for integration and testing long before any PlanetSpace's need for an actual engine. Engineering efforts on the upper stage and spacecraft are "design to" exercises. In other words, the upper stage and spacecraft are designed to withstand actual or expected performance loads induced by the launch vehicle and upper stage engines, as well as environmental stresses. Because the performance of the Castor 30 engine is designed to provide a specific thrust load, any load stress related to the Castor 30 will be incorporated into the design of the orbital transfer vehicle and remainder of the upper stage. Thus, PlanetSpace will not require delivery of a Castor 30 until late 2011. A delay in the production of a rocket motor of that length is extremely unlikely.

46. Even so, as noted above, and as provided in PlanetSpace's bid proposal, PlanetSpace has the option to use an Atlas V rocket for any mission. Therefore, PlanetSpace's second mission date will not be affected by delays in upper stage development.

Other Considerations

Two Launch Vehicle Plan

47. Launch payloads undergo stresses during launch, in part due to vibroacoustic phenomena caused by the launch vehicle rocket motors. Different launch vehicles impart different stresses on payloads. Accordingly, payloads, including the PlanetSpace orbital transfer vehicle, must be designed to withstand expected stresses caused by planned launch vehicles.

48. Using two different launch vehicles does not substantially increase the engineering timeline for the orbital transfer vehicle. In fact, this is built in to engineering timelines -- almost all commercial spacecraft are designed to fly on multiple launch vehicles because of unpredictability of launch vehicle availability and launch prices given the usual 30 to 36 months development timeline for spacecraft.

49. The problem is especially trivial where, as here, the launch vehicles to be used are well-characterized. The Atlas V vehicle has been launched 85 times, and stress data has been collected for each launch. As a result, payload stresses on the Atlas V, and thus design requirements for its payloads, are well-known. These data are collected in an Atlas V "user manual."

50. Likewise, the vibroacoustic environments generated by the Athena III RSRM first stage, derived as they are from the Space Shuttle RSRM's and having commonality with the Ares I, are predictable with a high degree of certainty. Lockheed and ATK have already estimated the launch loads the will be created by the Athena III.

51. Because the launch stresses that will be experienced by the orbital transfer vehicle are predictable with a high degree of certainty, PlanetSpace's subcontract partners can design the orbital transfer vehicle for the "worst case" launch stresses. According to predictions, Athena III will produce a slightly harsher vibroacoustic environment, and the orbital transfer vehicle's design will take this into account. These loads are well within ATK, Boeing, and Lockheed Martin's vast design experience. ATK and Lockheed Martin have built numerous launch vehicles of this size and load class in the past. Likewise, Boeing has designed and developed spacecraft (including the Space Shuttle, in conjunction with Rockwell) designed to withstand these loads.

52. Accordingly, designing the orbital transfer vehicle to be compatible with the Athena III will result in a spacecraft that can fly on both the launch vehicles within the [redacted] schedule provided above.

SpaceX and Orbital Sciences Corporation are Unlikely to Provide Resupply to the ISS Before PlanetSpace Can Do So

53. Based on my review of publicly available sources of information, including NASA statements, statements by SpaceX and Orbital, as well as information contained in a June 2009 report by the Government Accountability Office, both SpaceX and Orbital are developing the systems required for ISS Resupply using their funded Space Act Agreements with NASA (COTS). Through these COTS agreements, SpaceX is financing the development of its Falcon 9 launch vehicle and the Dragon orbital vehicle to be used in the ISS CRS missions. Likewise, Orbital is financing the development of its Taurus II launch vehicle and Cygnus orbital vehicle to be used in the ISS CRS missions. As such, I believe that both companies' performance under the COTS contracts is the most relevant factor in determining whether they will be able to meet each of their promised ISS CRS schedules.

54. After reviewing public information related to their performance on these contracts, and consulting other industry sources, I conclude the current ISS CRS contractors are likely to miss their milestones as proposed on the ISS CRS. I conclude that the number and nature of the delays experienced to date by these contractors indicate that future delays are highly likely, and that these cumulative delays will prevent the current ISS CRS contractors from being ready to conduct ISS missions prior to PlanetSpace.

Space X

55. SpaceX has promised to begin ISS CRS resupply missions in June 2010 – less than 1 year away. However, given the scope of delays already suffered by SpaceX and the amount of work left to do prior to being launch ready, this date is unlikely to be met. As provided in Fig 2 below, as of June, Space X was already 17 months behind its original COTS schedule a flight readiness review.

SpaceX			
Original Date of SAA Milestone	Milestone Title	New date with Amendment	Delay (Mo)
Sep 2006	Program Management Plan Review	No Change	0
Nov 2006	Demo 1 Systems Requirement Review	No Change	0
Jan 2007	Demo 1 Preliminary Design Review	Feb 2006	1
Mar 2007	Financing Round 1	No Change	0
Mar 2007	Demo 2 System Requirement Review	No Change	0
Aug 2007	Demo 1 System Critical Design Review	No Change	0
Oct 2007	Demo 3 System Requirements Review	No Change	0
Dec 2007	Demo 2 Preliminary Design Review	No Change	0
Feb 2008	Demo 1 Readiness Review	Mar 2009	17 and counting
Mar 2008	Financing 2	No Change	0
Apr 2008	Demo 3 Preliminary Design Review	June 2008	2
Jun 2008	Demo 2 System Critical Design Review	Sep 2008	3
Sep 2008	Demo 1 Mission	June 2009	10 and counting
Dec 2008	Demo 2 Readiness Review	Sep 2009	9
Jan 2009	Demo 3 System Critical Design Review	Sep 2008	-4
Mar 2009	Financing 3	No Change	0
June 2009	Demo 2 Mission	Nov 2009	5
July 2009	Demo 3 Readiness Review	Jan 2010	6
Sep 2009	Demo 3 Mission	Mar 2010	6
	Milestones accomplished and paid for (possible small delay in schedule)		
	Milestone not complete – significant delay – no payments made		
	Milestone reschedule date in future – impossible to achieve amended schedule – additional delays assured – payments pending completion		

Sources: *NASA Commercial Crew and Cargo Overview Presentation, available at* http://www.nasa.gov/pdf/361040main_20090617COTS_Status.pdf ("NASA COTS Presentation"); GAO Report to Congressional Addresses, *Commercial Partners Are Making*

Progress but Face Aggressive Schedules to Demonstrate Critical Space Station Cargo Transport Capabilities, June 2009, http://www.gao.gov/new.items/d09618.pdf ("GAO Report").

56. Despite the nearly 18 months of added time, SpaceX has yet to fly its Falcon 9 launch vehicle or its Dragon orbital vehicle. From the published milestone schedule, SpaceX appears to intend to make up some of this lost time by reducing the time in between the readiness review and the actual demonstration mission. *See* NASA COTS Presentation at 10.

57. In my experience, such scheduling increases the risk of failure substantially. For instance, if problems in mission readiness are found during the mission review, there is very little time in which SpaceX may correct any identified problem prior to launch. A scrubbed launch will set back the remainder of the schedule going forward.

58. Indeed, this issue may have already become apparent. Before SpaceX may launch its first demonstration mission, it must receive the approval of the 45th Space Wing Commander that its launch infrastructure and operations meet the USAF's launch range safety requirements. *See* GAO Report at 23. SpaceX itself has acknowledged the range safety approval process as a significant risk that could result in schedule slips. *Id.* As of June 2009, the United States Air Force 45th Space Wing has already expressed concerns that SpaceX's aggressive schedule may not give SpaceX sufficient time to submit its requests to modify USAF range safety requirements or give the USAF sufficient time to review, validate, and approve SpaceX's facilities and launch operations before scheduled demonstrations. *Id.*

59. In addition, there is a considerable risk that the Falcon 9 will not perform successfully on its first launch, thus endangering the ISS resupply mission schedule. The Falcon 9 is essentially a scaled up version of its Falcon 1 launch vehicle. The Falcon 9, which will use the same avionics as the Falcon 1, will be approximately 110 feet longer, seven feet wider, 600,000 lbs heavier, and have over 1,000,000 pounds more thrust. *Compare* Falcon 1

Specification, *available at* http://www.spacex.com/falcon1.php (describing Falcon 1 as having 78,000 lb/ft of thrust and 420kg payload capacity), *with* Falcon 9 Specification, *available at* http://www.spacex.com/falcon9.php (describing Falcon 9 as having 1.1 million lb/ft of thrust and 10,450kg payload capacity). The Falcon 9 has approximately 9 times the thrust and 22-times the carrying capacity of the Falcon 1. *Id.*

60. To date, SpaceX has attempted five launches of the Falcon 1, which uses one SpaceX designed and built Merlin liquid fueled rocket motor. Three of those attempts failed. Such failures include SpaceX's third launch attempt on August 2, 2008, which destroyed two NASA satellites and one Department of Defense satellite, *See* "Falcon 1 Flight 3 Launch Fails," Satellite Today, Aug. 5, 2008 (describing the failures of the Falcon 1's first three launch attempts -- March 2006, March 2007, and August 2008); *see also* Mike Swift, "Rocket Launch: Fourth Try a Charm?," San Jose Mercury News, Sept. 17, 2008, at A1.

61. SpaceX's fourth attempt at launching the Falcon 1, occurring in late September 2008, achieved orbit but did not carry a separable payload or payload simulator. In March 2009, Space X finally achieved a success in launching a customer satellite in low earth orbit. http://www.spacex.com/press.php?page=20090715.

62. While the success of the Falcon 1 mission does provide Space X with relevant data to use in the development of the Falcon 9, it is likely to be of limited utility. The Falcon 9 uses not one Merlin engine, but nine Merlin engines. In addition, the Falcon 9 would be a much more complex system than the Falcon 1, intended to carry twenty-two times more cargo. The Falcon 9 will use a fuselage that is 110 meters longer, seven feet wider, approximately 600,000 lbs heavier, and having 1,000,000 pounds more thrust than the Falcon 1.

63. A successful scale up of rocket size, thrust, and lift capacity presents a significant engineering challenge to any company. Such an engineering effort is likely to take an experienced, well-funded space systems company with expert subcontractors over 36 months to complete.

64. For instance, when McDonald Douglas Space Systems (now part of Boeing) attempted to increase the launch capability of its Delta vehicles by a factor 2 (Delta II to Delta III), it took approximately three years. *See, eg.,* The Cambridge Encyclopedia of Space, *Missions, Applications and Exploration* at 135, Table 6.2 (American launch vehicles in use or under development in 2001); Walter E. Hammond, Space transportation: A Systems Approach to Analysis and Design, 241-242 (American Institute of Aeronautics and Astronautics, Inc (AIAA) Date). However, that scale-up was not successful. McDonald Douglas attempted to launch the Delta III only three times, with two failures. *Id.*

65. McDonald Douglas achieved the desired increase in capacity with the Delta IV series. *Id.* However, this effort took four additional years and cost greater than $2 billion dollars to develop.

66. Unlike McDonald Douglas, SpaceX is not attempting to double the capacity of its Falcon 1. As noted above, the Falcon 9 is intended to have *twenty-two times* the cargo carrying capacity of the Falcon 1. I am aware of no company or country that has ever successfully scaled a prior successful rocket design to a new launch vehicle capable of an order of magnitude greater capacity in the time frame proposed by SpaceX.

67. In addition, the company may encounter additional delays owing to its structure. First, Space X is a vertically integrated company. Thus, all major components are designed and built in house. If, as is encountered in most large-scale projects, engineering

challenges become apparent that are outside of the in-house expertise, Space X will be forced to either hire personnel with relevant experience, or subcontract. Both of these solutions would take substantial time to implement, causing significant schedule delays. Indeed, in esoteric fields related to space craft design, relevant experience may not be readily available in the employment market or by way of subcontractors.

68. Second, rocket and spacecraft development from the ground up requires substantial financial reserves. As noted above, Space X has been developing the Falcon 9 launch vehicle and Dragon spacecraft, as part of a separate agreement with NASA -- a $278 million Commercial Orbital Transportation Services agreement. Of this $278 million, Space-X has been paid $234 million. *See GAO Report at* 23. Only $44 million in milestone payments remains on its COTS agreement, and no more money is due on that contract to Space X until its first actual Falcon 9 demonstration flight. This demonstration flight was originally set for September 2008 then re-set for June 2009, but now is not scheduled to take place until late 2009, at the earliest. *See* NASA COTS Presentation at 10.

69. SpaceX also has not performed a flight demonstration of the Dragon orbital vehicle, which is an essential part of its proposed solution to the ISS resupply requirements, which are the subject of the CRS procurement. The Dragon will not be flight tested until the Falcon 9 is developed.

70. Based on the foregoing and my experience with similar systems, I believe Space X will not be in a position to engage in ISS resupply activities prior to PlanetSpace.

Orbital Sciences Corporation

71. Orbital has promised to begin ISS CRS resupply missions in October 2011. Like Space X, Orbital has encountered delays in the performance of its COTS contract, resulting in doubt about the readiness of systems required for ISS Resupply.

72. OSC met its first COTS milestone (Program Kickoff) in March 2008. But, because of subsequent problems, as provided in Fig 3 below, Orbital's reported delays are already approximately six to seven months from its original COTS schedule:

Orbital			
Original Date of SAA Milestone	Milestone Title	New date with Amendment	Delay (Mo)
Mar 2008	Program Plan Review	Mar 2008	0
Jun 2008	Demo Mission SRR	Jun 2008	0
Jul 2008	Unpressurized Cargo Module Preliminary Design Review	Aug 2008	1
Sep 2008	Demo Mission Preliminary Design Review	Apr 2009	7
Oct 2008	COTS Integration/Operations Facility at Wallops Flight Facility Started	Sep 2008	-1
Nov 2008	Pressurized Cargo Module Preliminary Design Review	Oct 2008	-1
Nov 2008	Unpressurized Cargo Module Critical Design Review	DELETED	
Feb 2009	Complete Development of Instrumentation Program and Command List (IP&CL)	Feb 2009	0
NEW	Completion of ISS Phase 1 Safety Review	Mar 2008	NA
NEW	Pressurized Cargo Module Critical Design Review	Jul 2009	NA
Jun 2009	COTS Visiting Vehicle Avionics Test	Aug 2009	1
NEW	Completion of ISS Phase 2 Safety Review	Aug 2008	NA
Mar 2009	Demo Mission CDR	Sep 2009	6
Jul 2009	Unpressurized Cargo Module Fabrication Started	DELETED	
Oct 2009	Service Module Core Assembly Started	Dec 2009	2
Jan 2010	Service Module Test Readiness	Apr 2010	3

	Review		
May 2010	Service Module Initial Comprehensive Performance Test Complete	Jul 2010	2
Sep 2010	Launch Vehicle Stage 1 Assembly Complete	Oct 2010	1
NEW	Cargo Integration Demonstration	Dec 2010	NA
Oct 2010	Mission Readiness Review	Feb 2011	4
Dec 2010	Demo Flight	Mar 2011	3
	Milestones accomplished and paid for (possible small delay in schedule)		
	Milestone rescheduled with significant delay		
	Milestone more than 6 months late when completed or reschedule date in future – unrealistic date based on CDR slipping 6 months or more - payments pending completion		

Sources: *NASA Commercial Crew and Cargo Overview Presentation*, *available at* http://www.nasa.gov/pdf/361040main_20090617COTS_Status.pdf ("NASA COTS Presentation"); GAO Report to Congressional Addresses, *Commercial Partners Are Making Progress but Face Aggressive Schedules to Demonstrate Critical Space Station Cargo Transport Capabilities*, June 2009, http://www.gao.gov/new.items/d09618.pdf ("GAO Report").

73. For the reasons provided below, Orbital's ISS CRS schedule is likely to be delayed further.

74. First, OSC intended to launch ISS CRS payloads on its new the Taurus II and the Cygnus cargo vehicle. The original Taurus I, a smaller vehicle, has some record of success. The Taurus I launched successfully on 6 of 8 attempts, but has failed on 2 of its last 3 attempts, including a launch on February 24, 2009 that destroyed NASA's $273 million Orbiting Carbon Observatory. *See* Robert Block, "$273M Mission's Demise Disheartens NASA," Orlando Sentinel, Feb. 25, 2009, at A2.

75. The proposed Taurus II will be substantially different from the existing launch vehicle. It will be liquid fueled instead of solid fueled, and approximately 27 feet longer, 5 feet wider, and 250,000 pounds heavier. *Compare* Taurus II (Presentation by David Steffy, OSC), *available at* http://www.aiaa.org/pdf/conferences/Steffy_NRO-AIAA_Conference_Paper--Steffy.pdf (Height = 40.5 m., Diameter = 3.9 m., Weight = 290,000 kg.), *with* Taurus, *available*

at http://www.orbital.com/NewsInfo/Publications/Taurus_fact.pdf (Height = 27 to 32 m., Diameter = 2.3 m., Weight = 150 to 170,000 kg.). The first stage of the Taurus II will be manufactured in the Ukraine. *See* Carol Vaughin, "Bright Future Seen for Taurus II Project, Wallops Island," *DelMarva News*, Aug. 9, 2009, *available at* http://www.delmarvanow.com/article/20090809/NEWS01/908090332/1002/rss (last visited on Aug. 27, 2009).

76. The Taurus II's original configuration, selected by NASA for ISS resupply, was to employ two (2) Russian built AJ-26 engines (formerly designated NK-33). However, within the last month, I have been informed that Orbital is considering a change to the specification of the Taurus II launch vehicle instead to employ a Russian built RD-180 engine rather than two AJ-26 engines.

77. Such a change will certainly cause schedule delays. The RD-180 engine has a different, and more powerful, thrust profile than the AJ-26 engines, among other things. Changing the engine will not only require time and engineering effort to redesign the launch vehicle, but it will also likely require design changes to the Cygnus cargo vehicle. To the extent that the Cygnus has been already been designed, it was designed to ride atop the first specification of the Taurus II using AJ-26 engines. As a result, the Cygnus may have to be redesigned to withstand the loads imposed by the new launch vehicle.

78. Prior to this change, the Government Accountability Office found that OSC's aggressive schedule could present challenges with completing requirements in NASA's International Space Station to COTS Interface Requirements Document in time for its March 2011 demonstration mission launch date under COTS, and subsequent ISS CRS missions. *See*

GAO Report at 30. There is no doubt that the Taurus II redesign, necessitating a redesign of the Cygnus, will not be able to be accommodated in Orbital's already compressed schedule.

79. Based on the foregoing and my experience with similar systems, I believe Orbital will not be in a position to engage in ISS resupply activities prior to PlanetSpace.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Executed this 27th day of August, 2009.

Michael Bowker

MB 8/27/09